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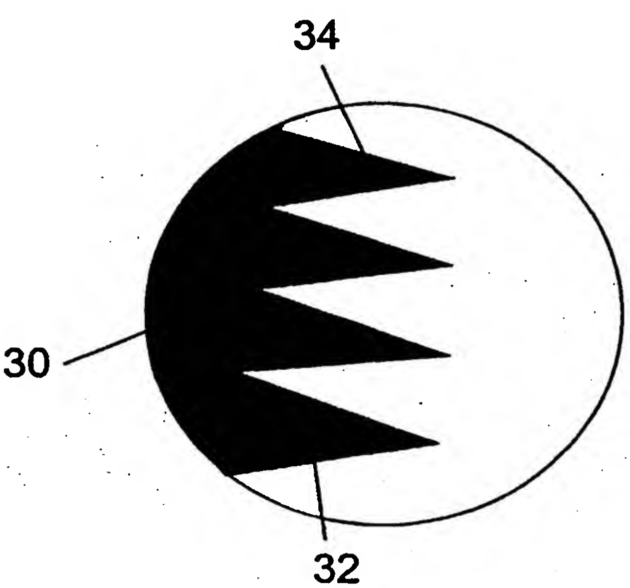

(57) Abstract: A soft edge plate for use in the projection of an image onto a viewing screen is provided. It comprises a transparent area, an opaque area, and a semi-transparent area between said transparent area and said opaque area. The semi-transparent area comprises an alternating macroscopic pattern of discrete opaque and transparent areas. A soft edge plate with a pattern as described above, applied in metal on a glass substrate, may in particular be used for soft edging LCD projectors.

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OPTICAL SOFT EDGE MATCHING METHOD FOR LIGHT VALVE PROJECTORS

FIELD OF THE INVENTION

The present invention is situated in the field of projection systems in a multiple channel arrangement, such projection systems projecting an image (composite image) which is subdivided in two or more sub-images each projected by means of a separate projector element, the sub-images being tiled in such a way that together they form a bigger image. The advantage of this method of projection is that the field of view can be increased while maintaining a high image resolution. This kind of large field of view projection systems serve different broad areas of application:

- electronic presentations for business, education, advertising.
- entertainment, e.g. home theatre, electronic cinema.
- status and information, e.g. military, utilities, transportation.
- simulation in e.g. training and games.

The projectors are light valve projectors in particular.

BACKGROUND OF THE INVENTION

The tiling of sub-images can be done by applying hard edge or soft edge techniques.

Where hard edge techniques are applied, the projected sub-images are put next to each other. This is often not an optimal solution because the edges between the sub-images are difficult to arrange in perfect alignment and the join may well be noticeable.

Where soft edge techniques are applied, an overlap area is created in which two or more sub-images, i.e. at least a first sub-image and a second sub-image, are blended so that there is at least a gradual transition from the first sub-image to the second sub-image. Therefore the first sub-image is progressively spatially faded out whilst the other image is progressively faded in. This is illustrated by means of Figure 1. In Figure 1, a first sub-image 2 and a second sub-image 4 are projected by means of a first projector 6 and a second projector 8 respectively in such a way that an overlap area 10 is created in the image 12 on the screen, namely in the area which is illuminated by more than one projector. In case of a good soft edge, the sub-images 2, 4 are processed (optically or electronically) in such a way that the sum of the light intensity in the overlap area 10 is equal to the average intensity outside the overlap area 10, and in such a way that the contribution of the first projector 6 to this total intensity in the image 12 changes gradually from maximum to zero from one side of the overlap area 10 to the other side of the overlap area 10, while the contribution of the second projector 8 to this total intensity

changes gradually from zero to maximum from one side of the overlap area 10 to the other side of the overlap area 10.

The blending of projected sub-images through use of electronic processing is known. US 5,966,177 assigned to SEOS Displays Limited describes such an electronic processing, whereby the intensity of the image provided to the projection apparatus is modulated with a modulation waveform which takes into account the response of the image display apparatus to the video signal, in order that the combined image from all display projectors forms an overall image of he correct intensity in the overlap region.

Electronic processing can also be applied to light valve projectors, as is also mentioned in WO 99/29116 of Barco N.V. However, a problem of light valve projectors can be that, due to their limited contrast ratio, the darkest image level may still have a certain amount of leakage light. This amount of leakage light is independent of the amount of electronic reduction that is performed. As a result the black (or dark zone) level leakage light is added in the overlap area, and the contrast ratio will be locally divided by 2 in at least said overlap area. The darkest image level is the lowest light level that can be achieved by a light valve projector. Therefore, it is not possible to further lower this level by electronic signal correction.

An optical soft edge mask for a slide projector is described in US 5,077,154 of Ferrand D. E. Corley. It comprises a panel, a mask portion defined by a substantially opaque area of said panel, a clear portion defined by a substantially light transmitting portion of said panel, and a margin portion extending between the opaque portion and the transparent portion. The margin portion has a light transmissibility which varies progressively from the mask portion to the transparent portion, e.g. by means of a plurality of strips of progressively varying light transmissibility. The soft edge masks described are intended to be used in a slide projector, which means that they are placed in a light path having a light power and, therefore, temperatures generated in optical components limited by the celluloid of a slide. Special materials must be used for the mask, such as a low contrast film which provides a lot of grey tones in order to obtain a smooth intensity variation. These special materials are generally not suitable for use in a light valve projector, such as an LCD projector because in such devices, polarised light is used. A lot of materials cannot be used in the light path of an LCD projector as they result in double refraction.

US 5,978,142 assigned to SEOS Display Limited describes another method to apply a soft edge processing on a sub-image in a tiled display by using a supplementary light modulator in combination with a complete light valve projector. However this method requires the use of a number of complex extra components like the extra light modulator

with its drive electronics and some relay optics. Furthermore the extra optical elements, particularly the extra light modulator can cause a substantial decrease of light output of the projector.

It is an object of the present invention to provide a soft edge plate or soft edge mask and a method of operating the same for obtaining good soft edging which does not require complex extra components and which is economical.

It is a further object of the present invention to provide a soft edge plate or soft edge mask and a method of operating the same for light valve projectors, especially for LCD projectors.

SUMMARY OF THE INVENTION

The above objective is accomplished by providing a soft edge plate (also called soft edge mask) comprising a transparent area, an opaque area and a semi-transparent area between the transparent area and the opaque area, whereby the semi-transparent area comprises an alternating pattern of discrete opaque and transparent areas. The alternating areas may be described as opaque and transparent dithered regions. The semi-transparent area may be a margin region of at least part of a frame defined by the opaque area. The opaque areas may be formed from a patterned layer. The patterned opaque layer may be formed, for example, by a deposition of material such as metal followed by etching. However, the opaque layer may be self-supporting. The opaque and transparent areas of the pattern may be made of different materials, e.g. metal and air (that is no solid material). The pattern may be described as "macroscopic" by which is meant that the pitch of the pattern is at least 5 times the wavelength of the light to be projected, or at least 10 times, 20 times or 50 times. In the direction away from the opaque area (or towards the transparent area) the semi-transparent area has an average opacity which reduces gradually, monotonically, piece-wise smooth, or step-wise with distance from the opaque area.

It is the semi-transparent area which provides a soft edge margin region on the mask or plate. The transparent area of the plate in the margin region may extend from a first outer portion of the semi-transparent area into substantially the inner portion of the transparent area over the whole width thereof, while the opaque area may extend from a second outer portion of the semi-transparent area into substantially the inner portion thereof, over the whole width of the semi-transparent area. Alternatively, the opaque and transparent areas of the margin may be formed in a checkerboard pattern, interlaced or interleaved pattern. The opaque regions may be black or any other colour or may be reflective.

The semi-transparent area is provided with an opaque and transparent pattern on macroscopic scale. This pattern may e.g. be a symmetric sawtooth pattern, a real sawtooth pattern, a sawtooth pattern with curved edges, a step pattern, or any other pattern which comprises opaque parts extending from a first outer portion of the semi-transparent area over its whole width, and at the same time transparent parts extending from a second outer portion of the semi-transparent area over its whole width as well as checkerboard or interleaved or interlaced patterns.

The opaque area and the opaque parts of the semi-transparent pattern in the semi-transparent area of the plate are preferably provided by applying a high-temperature opaque layer, e.g. a metal layer (e.g. by a suitable application technique such as metal deposition) on a transparent carrier, preferably a high-temperature substrate such as e.g. glass. The metal layer may be absorbing and/or reflecting for light falling onto it.

Metal deposition can be done by an automated and accurate photolithographic process, which is very reliable. The high accuracy and reliability of the patterning technique is especially required for an optimal convergence of the different colour channels in a set of blended multiple light valves for the multiple primary colour channels. Such a photolithographic process allows a very fast manufacturing route for the soft edge plates, whereby these plates can be provided in any size and in a whole range of gradations of opacity by simply changing the pattern applied. The range of gradation of opacity can easily be controlled by using soft edge plates having different patterns according to the present invention. Also the size (width) of the margin region can be easily varied.

By using, for example, a transparent glass substrate with an anti-reflective coating, with a metal layer deposited upon it for applying the opaque area and the opaque parts of the semi-transparent area, the soft edge plate can in particular also be used in or with light valve projectors such as LCD projectors.

According to an embodiment of the present invention, the soft edge plates are placed inside or outside each of the projectors of a projecting system generating overlapping sub-images which together form a bigger image, more particularly in the light path of each of those projectors. These projectors may be light valve projectors, and more specifically they may be transmission or reflection LCD projectors. The soft edge plates may be placed in the neighbourhood of the one of more light valves (monochrome respectively full colour), being LCDs in case of an LCD projector. The soft edge plates can be put either at the illumination side of the at least one light valve, or at the image forming side thereof. Preferably, the projectors are digital projectors, that is they display a digital image by modulating a digital light modulating device such as a light valve, pixel-

by-pixel.

The present invention also includes a method of forming a soft edge projection of two overlapping images, comprising the steps of: projecting the two images to form an overlapping region; and forming the overlapping region by projecting light through two semi-transparent areas to form an out-of focus image thereof, each semi-transparent area comprising an alternating pattern of discrete opaque and transparent areas.

Other features and advantages of the present invention will become better understood through a consideration of the following detailed description, taken in conjunction with the accompanying drawings, which illustrate, by way of example, the principles of the invention.

This description is given for the sake of example only, without limiting the scope of the invention. The reference figures quoted below refer to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates the known principle of soft edging of projectors.

Fig. 2 is a diagrammatic illustration of a soft edge plate placed on the illumination side of a light valve according to an embodiment of the present invention.

Fig. 3 is a diagrammatic illustration of a soft edge plate placed on the image forming side of a light valve according to another embodiment of the present invention.

Fig. 4A shows an embodiment of the design of a soft edge plate according to the present invention, and Fig. 4B is an enlarged fragmentary view showing more detail of the soft edge plate of Fig. 4A.

Fig. 5 is a schematic illustration of soft edge plates according to an embodiment of the present invention incorporated in a 3-LCD projector.

Fig. 6 illustrates the positional adjustment of a soft edge plate according to an embodiment of the present invention.

Fig. 7 illustrates the positive effect of a soft edge plate according to embodiments of the present invention when it is projected out of focus.

Figs. 8A to 8G illustrate different examples of opaque and transparent patterns according to embodiments of the present invention. Fig. 8H is a schematic cross-section through any of the patterns of Fig. 8A to G.

DESCRIPTION OF THE ILLUSTRATIVE EMBODIMENTS

The present invention will be described with respect to particular embodiments and with reference to certain drawings but the invention is not limited thereto but only by the claims. The drawings described are only schematic and are non-limiting.

Figs. 2 and 3 are diagrammatic illustrations of a transmissive type light valve

projector. Light is generated in a lamp 14 and sent towards the illumination optics 18 by means of a reflector 16. The illumination optics 18 integrate the light coming from the reflector 16 and generate a uniform light distribution on the light valve 20. The light valve 20 modulates the received light and creates an image. In particular, the light valve can be driven by a digital imaging system. This image is projected on a screen 22 by means of a projection lens 24. The screen 22 may be flat or curved, and reflecting the image (front projection) or transmitting the image (rear projection). The image may be viewed directly or indirectly via mirrors, collimating mirrors or other viewing devices.

According to an embodiment of the present invention, in order to obtain soft edged images, a soft edge mask or soft edge plate 26 is placed inside or outside a projector and projected in an out-of focus mode. The soft-edge plate may be placed In the neighbourhood of the light valve 20 in the optical configuration of a transmissive type of light valve projector, either on the illumination side thereof, as represented in Fig. 2, or on the image forming side thereof, as represented in Fig. 3. The soft edge plate 26 should lie in the optical path.

In Fig. 4A is illustrated that the soft edge plates 26 have a transparent area 28, an opaque, e.g. black area 30 and an intermediate semi-transparent area 32. The semi-transparent area 32 is made of an opaque, e.g. black, and transparent discrete pattern 34. This pattern 34 may be formed in some embodiments by a transparent area 28 of the soft edge plate extending from a first outer portion 31 of the semi-transparent area 32 into the inner portion of the semi-transparent area 32 over its whole width. At the same time, the opaque area 30 of the soft edge plate extends from a second outer portion 33 of the semi-transparent area 32 into its inner portion over its whole width. The opaque and transparent pattern is for instance a sawtooth pattern 34 as shown in the enlarged part of Fig. 4B. The sharp corners of such a pattern are preferably rounded off. Other examples of patterns are given in Figs. 8A to 8G. The present invention is, however, not limited to the examples given and other patterns are possible, as will be appreciated by a skilled person.

Fig. 8A shows a symmetrical sawtooth pattern, Fig. 8B shows a real sawtooth pattern, and Fig. 8D shows a step pattern. These patterns give a linear transition from one picture to another. Fig. 8C shows a curved sawtooth pattern, which gives another kind of transition. Fig. 8D shows a castellated pattern. Figs. 8E and F show checkerboard patterns with decreasing opacity as the pattern approaches the transparent region. Fig. 8G shows a pattern formed from discrete circular areas. In all these patterns 28 is the transparent region, 30 the semi-transparent region and 32 the opaque region. In any of the patterns of Figs. 8A to G, the pattern may be formed from a

plurality of smaller dots which may be applied with a pseudo-random or "dither" pattern. A cross-section through any of the patterns in accordance with one embodiment of the present invention of Figs. 8A to G is shown schematically in Fig. 8H. It comprises steps or islands of opaque materials which have been applied, e.g. by vacuum deposition of a metal followed by etching using a photo-lithographically defined etch mask as is well known to the skilled person in semiconductor processing. However, the soft edge mask could comprise only opaque material which is a self-supporting mask, e.g. having a pattern such as shown in Figs. 8A to D. The skilled person will appreciate that in the direction away from the opaque area (or towards the transparent area) any of the semi-transparent areas in accordance with embodiments of the present invention has an average opacity which reduces gradually, monotonically, piece-wise smooth, or step-wise with distance from the opaque area.

These opaque and transparent patterns can be applied with a very high accuracy e.g. by photo-lithographic processes.

The pitch of the pattern 34 and the size of the macroscopic elements making up the pattern is limited by the resolved resolution of the projection lens 24 at the location where the soft edge plate 26 is placed. If it is put very close to the focus plane of the projection lens 24 on the light valve 20, the pitch of the dithering pattern is preferably not higher than the pitch of the light valve pixels. If the soft edge plate 26 is put further away from the focus plane on the light valve 20, the pitch of the dithering pattern 34 can be higher.

On the other hand, the pitch of the pattern 34 is by preference higher than 5 times the wavelength of the light for which it is used. This is to avoid diffraction losses that will create ghost images, because the first and higher order diffracted beam will follow an optical path different from the zero-order diffracted beam. Also, in the projector it will modify the function which defines the macroscopic transmission variation from transparent to black, depending on the wavelength of the light. This will create different soft edge functions for the different primary colours in colour projectors, and lead to a lower quality soft edge. The pitch of the opaque/transparent pattern may also be at least 10 times, at least 20 times, at least 50 times of the wavelength of the light to be projected. In particular, if the soft edge mask is placed between the light valve and the projection lens or outside the projector between projector and screen, the diffraction effect can become more pronounced and can lead to ghost images on the screen. In such a case the pitch of the pattern forming the soft edge should be relatively large, e.g. more than 50 times the wavelength of the light projected. Typical values for the pitch of the soft edge mask pattern are 50 to 200 micron when the pixel pitch of the light valve is

between 20 and 100 micron. For a soft edge to be placed outside the projector a pitch of 500 micron to 2 mm is preferred.

In projectors 36 with three light valves 20B, 20G, 20R, soft edge plates 26B, 26G, 26R are put in the three colour channels, and they have a matching transparent, black and intermediate area (the same or mirrored). Fig. 5 shows an example of the introduction of soft edge plates 26B, 26G, 26R in a 3-LCD projector 36. Again the light source or lamp 14 and reflector 16 and illumination optics 18 are present in this configuration. The light is split into different colour channels by means of dichroic mirrors 38, 39. The light of each colour channel is integrated by a field lens 40B, 40G, 40R to generate a uniform light distribution on the light valves 20B, 20G, 20R, and is then recombined by means of an X-cube 42. The soft edge plates 26B, 26G, 26R are located in the neighbourhood of the LCDs 20B, 20G, 20R, at the illumination side thereof. According to another embodiment of the present invention, they could be placed at the image forming side thereof.

The dimensions of the semi-transparent areas 32 on each of the soft edge plates 26B, 26G, 26R have to be accurately equal in the three light valves of a 3-light valve projector 36 in order to have a matching black and semi-transparent area on the screen 22. In order to rule out mechanical tolerances on the positioning of the soft edge plates 26B, 26G, 26R, these soft edge plates 26B, 26G, 26R are by preference aligned in the horizontal and vertical direction, and also the rotation angle in the planes of the soft edge plates are by preference controllable. Figure 6 shows this adjustment. Each soft edge plate 26 (respectively 26B, 26G, 26R) is placed parallel with a corresponding light valve 20 (respectively 20B, 20G, 20R). A horizontal alignment in the direction of arrow H, a vertical alignment in the direction of arrow V and a rotational alignment in the plane of the soft edge plate, according to arrow R, can be carried out. Only in this way it is possible to match the black and semi-transparent areas as projected on the screen 22 for the three colours (convergence), and there is no discolouring in this area. In a proper alignment, the overlap area is perfectly gradual from black over neutral grey to white when it is only illuminated by a single projector.

An alignment of the soft edge plates is also preferable to fine-tune the soft edge plates of two adjacent projectors so that their complementary semi-transparent areas match perfectly. The accuracy to get a perfect overlap area, whereby the total light output remains almost constant over the total overlap area, is equal or close to the pixel pitch of the light valve.

The material of the soft edge plates may be chosen so that the reflectivity is as low as possible, in case multiple reflections with the light valves, ghost images, and photo-

conductivity problems in the case of LCD projectors are a problem. By preference, the soft edge plates are constructed on glass plates with an anti-reflective coating. Any transparent plastics material with a low double diffraction such as Plexiglass™ could also be used. The alternating opaque and transparent semi-transparent can also be self-supporting so that there is no transparent material used. The material applied on the opaque area and the opaque parts of the pattern, is required to have a good resistivity to heat dissipation. Preferably metal is used, which may be fully reflecting metal, absorbing metal or an intermediate form (partially reflecting and partially absorbing the light falling onto it). Absorbing metal will heat, thus causing stresses on the soft edge plate, while reflecting metal will heat much less. Normally the reflected light does not cause interference with the incoming light in the light path. Instead of metal also inks or varnishes, such as stove varnish, with a good heat resistance and heat dissipation can be used.

Fig. 7 is a graph of the intensity on the screen in function of distance along the screen if two images, a first sub-image 2 and a second sub-image 4, with the same light intensity are projected on a screen with an overlap area 10. The pattern 34 results in a discontinuity in the macroscopic transmission at the start and the end of the semi-transparent area if the soft edge plates 26 are in focus, as represented by the solid lines 50, in points 51, 52, 53 and 54. This is caused by the fact that it is impossible to generate a pattern 34 which starts and ends with an infinitely small thickness. This discontinuity is smeared out by installing each soft edge plate 26 sufficiently far away from its corresponding light valve 20. Because a light valve is projected in focus, the soft edge plate will be displayed sufficiently out of focus, which will smear out the light distribution and remove any remaining hard edges, as represented by the dashed lines 55. The soft edge plates have to be adjusted so that a sufficiently big black area 30 is projected, to allow for a good "diffusion" of the remaining hard edge that agrees with the start of the intermediate semi-transparent area 32. The complementary soft edge plate in the projector producing the adjacent image, has to be shifted with adjustments as shown in Fig. 6, so that the total illumination in the overlap area 10 is as equal as possible. This is denoted by the upper dashed line 56 in Fig. 7. If the soft edge plates are shifted too much away from each other, the total light intensity in the overlap area 10 will be too low and a dark area will be visible. If the soft edge plates are shifted too close to each other, the total light intensity will be too high and the overlap area will be too bright.

While the invention has been shown and described with reference to preferred embodiments, it will be understood that various changes or modifications in detail may be made without departing from the scope and spirit of this invention.

CLAIMS

1. A soft edge plate for use in projection of an image onto a viewing screen, comprising a transparent area, an opaque area, and a semi-transparent area between said transparent area and said opaque area, characterised in that the semi-transparent area comprises an alternating pattern of discrete opaque and transparent areas.

2. The plate according to claim 1, characterised in that the transparent area of the plate extends from a first outer portion of the semi-transparent area into substantially the inner portion of said semi-transparent area over the whole width thereof, while the opaque area of the plate extends from a second outer portion of the semi-transparent area into substantially the inner portion thereof over the whole width of the semi-transparent area.

3. A soft edge plate according to claim 2, characterised in that the opaque and transparent pattern is a sawtooth pattern.

4. A soft edge plate according to any of the previous claims, characterised in that the opaque area is provided by applying a metal layer on a transparent carrier.

5. A soft edge plate according to claim 4, characterised in that the metal layer is at least partially reflecting the light falling onto it.

6. A soft edge plate according to claim 4 or 5, characterised in that the metal layer is at least partially absorbing the light falling onto it.

7. A soft edge plate according to any of the previous claims, characterised in that the semi-transparent area is formed on a glass carrier.

8. A soft edge plate according to claim 7, characterised in that the glass carrier is coated with an antireflective coating.

9. A projector including a soft edge plate according to any of the claims 1 to 8.

10. A projector according to claim 9 wherein the soft edge plate is placed at a position

within the projector so that an out-of-focus image of the semi-transparent area is projected.

11. A projector according to claim 9 or 10, wherein the projector is a light valve projector.

12. A projector according to claim 11, wherein the soft edge plate is placed at the illumination side of a light valve.

13. A projector according to claim 11, wherein the soft edge plate is placed at the image forming side of a light valve.

14. A projector according to claim 11, wherein the soft edge plate is placed outside the projector.

15. A projector according to any of claims 11 to 14, wherein the light valve projector is a 3-LCD projector

16. Use of a soft edge plate according to any of the claims 1 to 8 in a light valve projector, whereby the soft edge plate is placed at the illumination side of the light valve.

17. Use of a soft edge plate according to any of claims 1 to 8 in a light valve projector, whereby the soft edge plate is placed at the image forming side of the light valve

18. Use of a soft edge plate according to claim 16 or 17, wherein the light valve projector is a 3-LCD projector.

19. A method of forming a soft edge projection of two overlapping images, comprising the steps of: projecting the two images to form an overlapping region; and forming the overlapping region by projecting light through two semi-transparent soft-edge areas to form an out-of focus image thereof, each semi-transparent soft-edge area comprising an alternating pattern of discrete opaque and transparent areas.

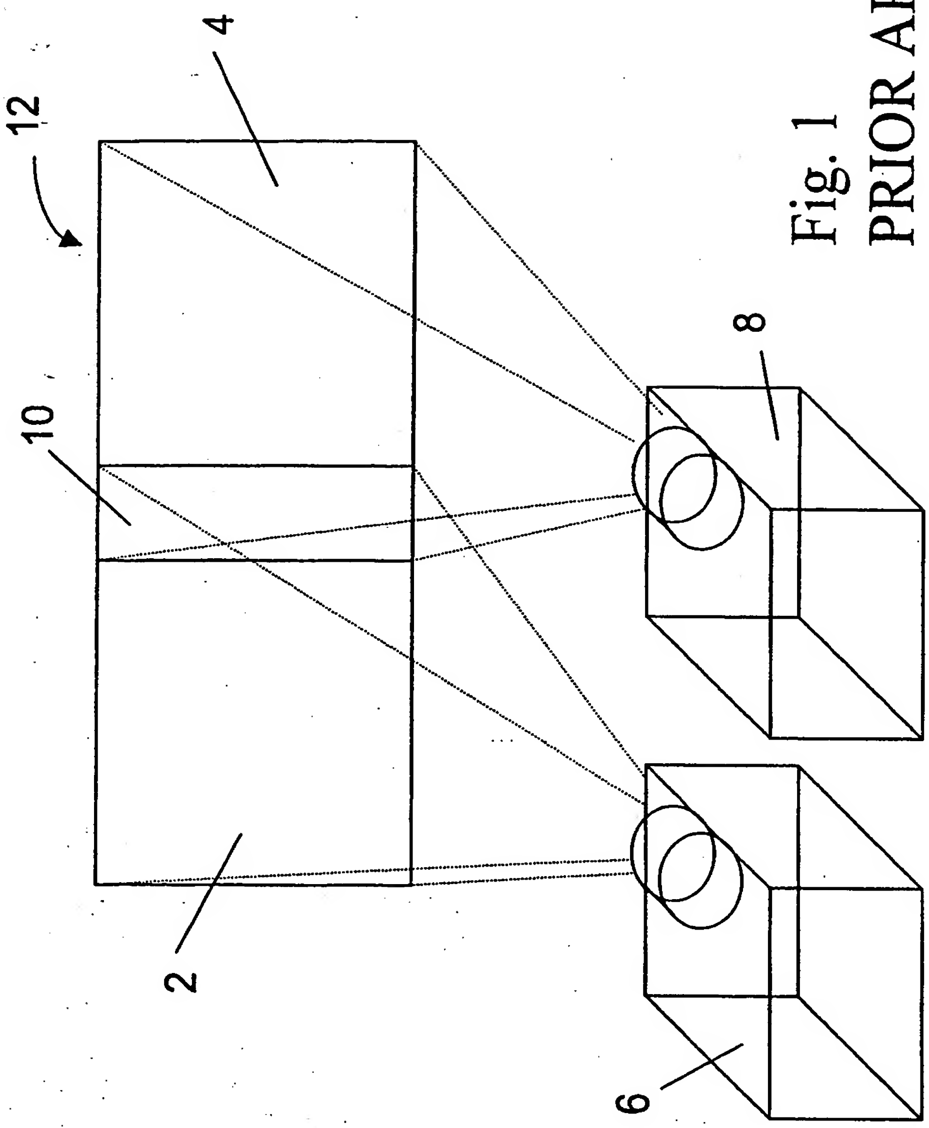

Fig. 1
PRIOR ART

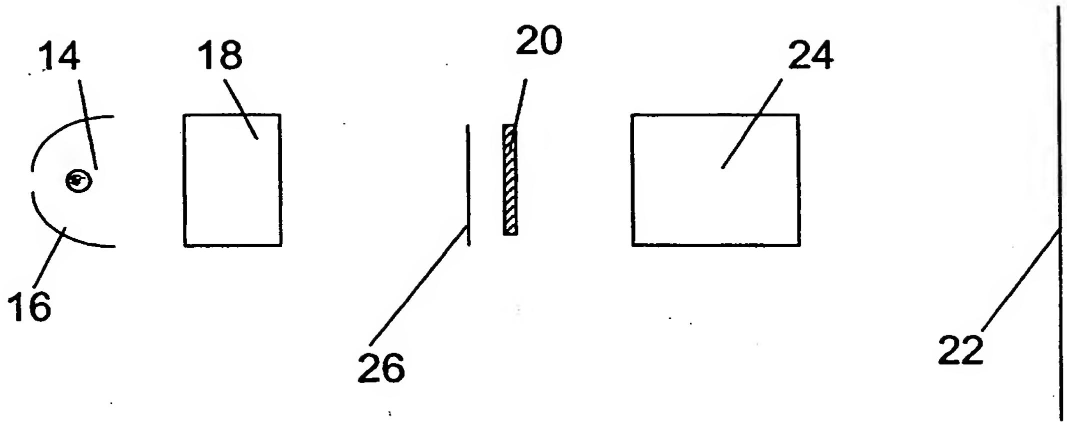

Fig. 2

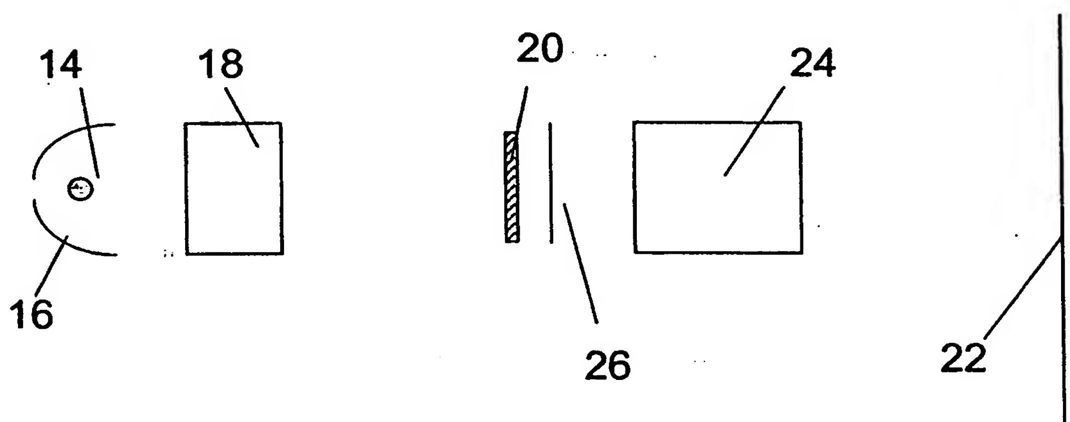

Fig. 3

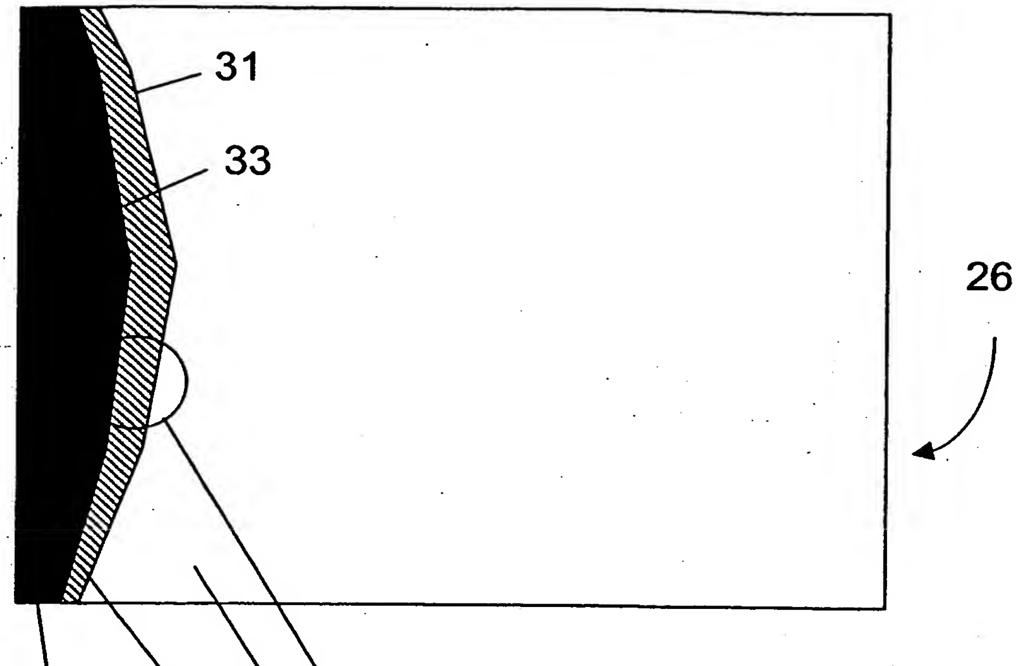

Fig. 4A

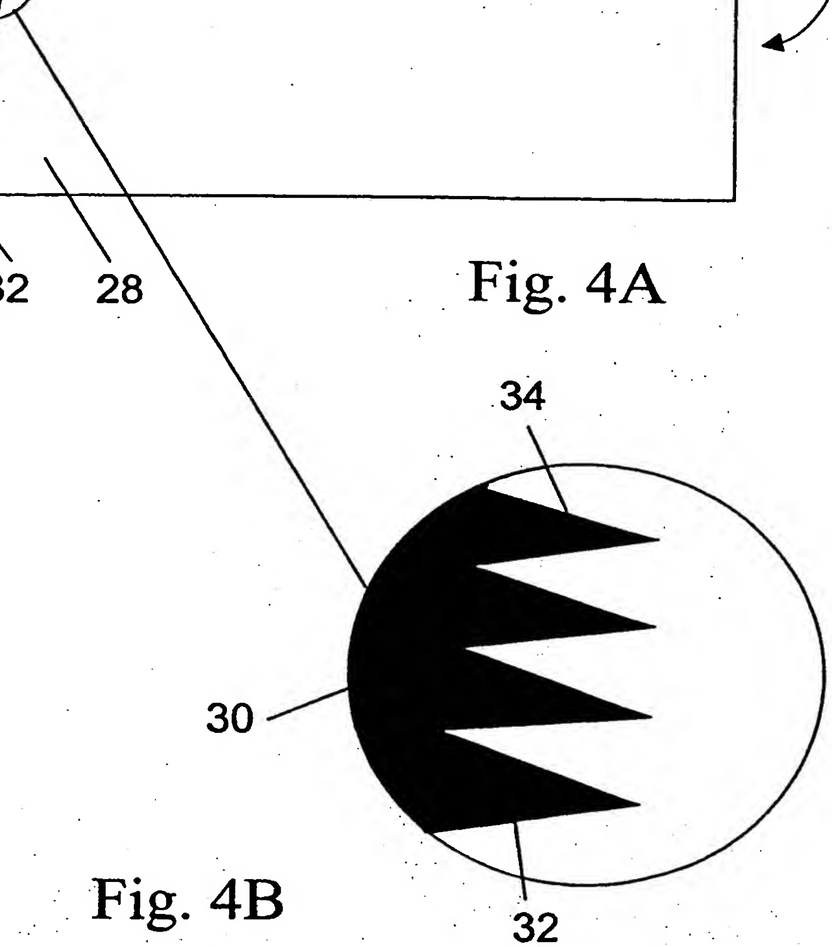

Fig. 4B

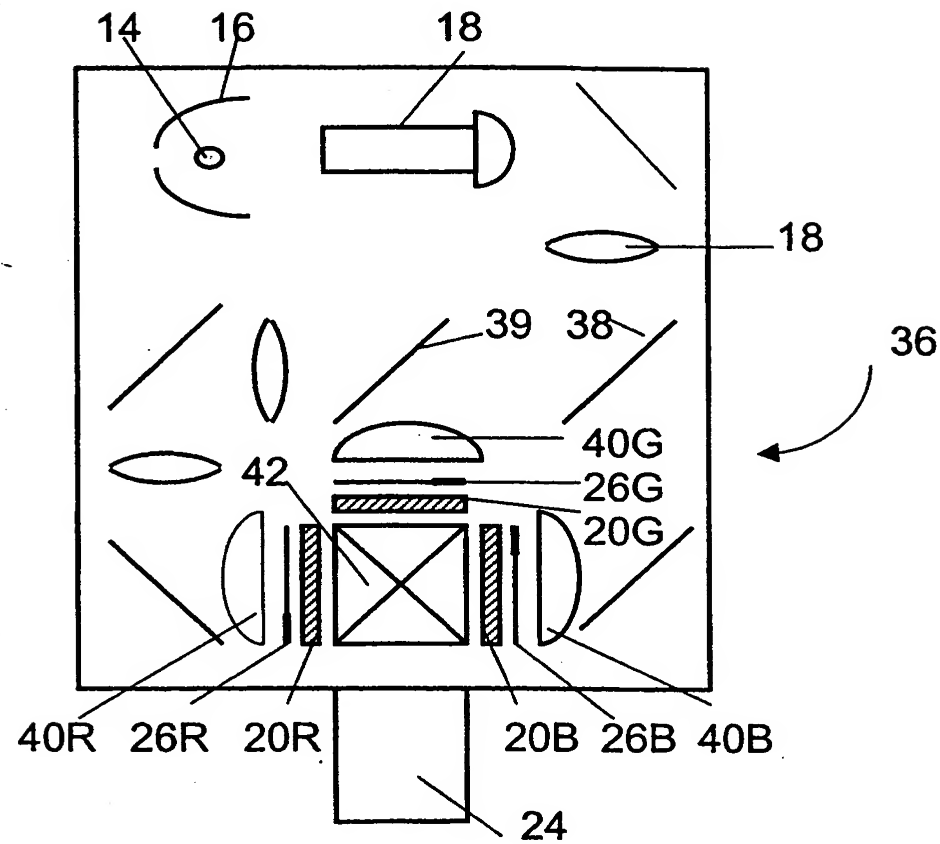

Fig. 5

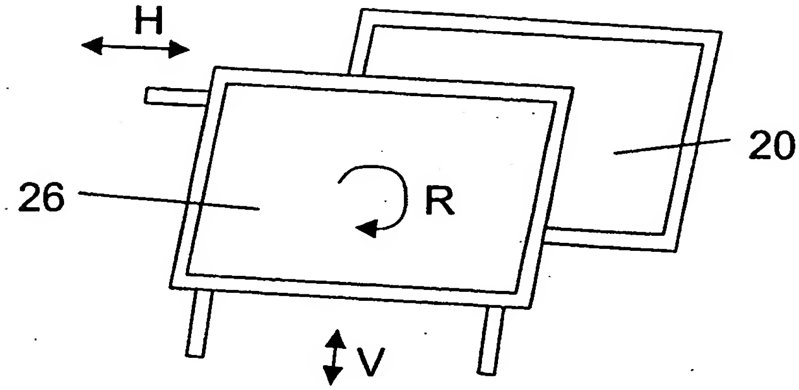

Fig. 6

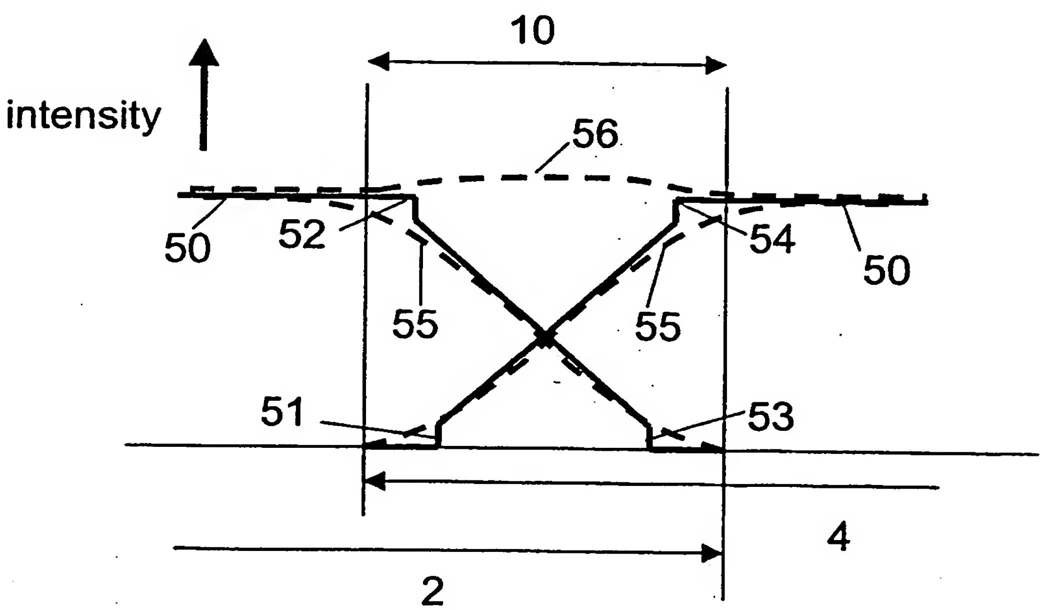

Fig. 7

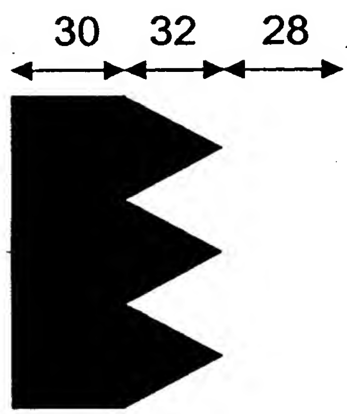

Fig. 8A

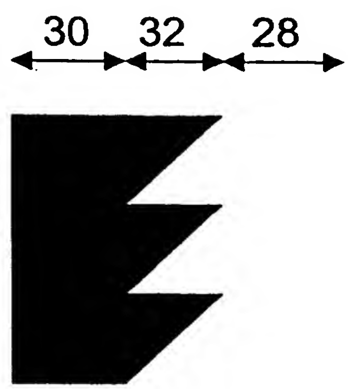

Fig. 8B

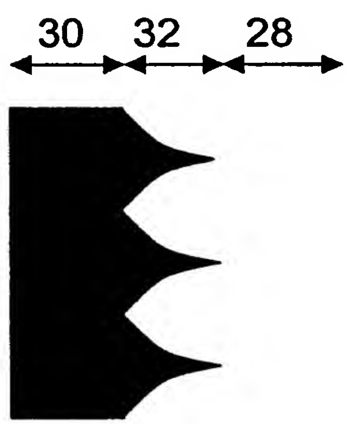

Fig. 8C

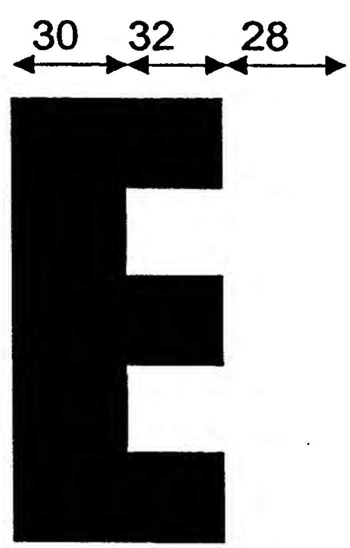

Fig. 8D

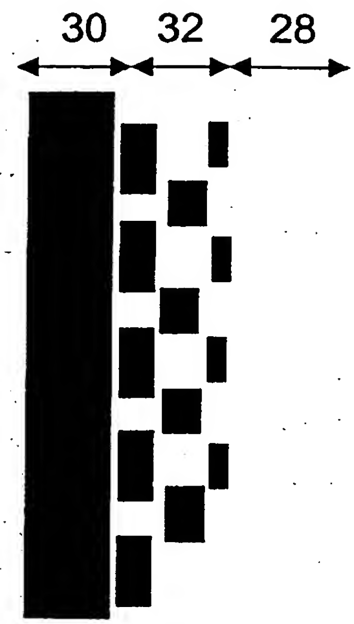

Fig. 8E

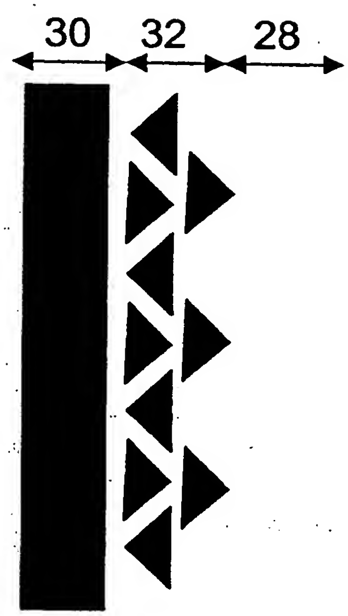

Fig. 8F

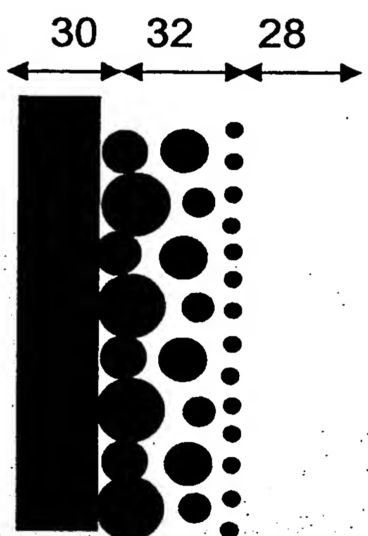

Fig. 8G

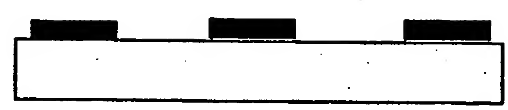

Fig. 8H

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 00/11910

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N9/31

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 95 25292 A (THOMSON TRAINING & SIMULATION ;BRIDGWATER RAYMOND JOHN (GB)) 21 September 1995 (1995-09-21) abstract; figures 1,2 page 3, line 22 -page 5, line 12 ---	1-4,9-19
A	EP 0 786 687 A (HUGHES JVC TECH CORP) 30 July 1997 (1997-07-30) the whole document ---	1-19
A	PATENT ABSTRACTS OF JAPAN vol. 1996, no. 03, 29 March 1996 (1996-03-29) & JP 07 302064 A (CANON INC), 14 November 1995 (1995-11-14) abstract ---	1,19

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 March 2001	10/04/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Pigniez, T

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 077 154 A (CORLEY FERRAND D E) 31 December 1991 (1991-12-31) cited in the application abstract; figures 1,2	1,19
A	FR 2 504 695 A (MACRESY CREATIONS SIMON SARL) 29 October 1982 (1982-10-29) claim 1; figures 4-7	1,3,4,19

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 00/11910

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9525292 A	21-09-1995	AU 1902395 A	03-10-1995
		ZA 9502207 A	07-12-1995
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FR 2504695 A	29-10-1982	NONE	